

AN EXPERIMENTAL CONTRIBUTION TO INTESTINAL SURGERY WITH SPECIAL REFERENCE TO THE TREATMENT OF INTESTINAL OBSTRUCTION.<sup>1</sup>

(CONTINUED.)

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THE many failures which attended jejunoo-ileostomy and ileo-ileostomy by lateral apposition and suturing led to the use of perforated approximation discs. A great contrast was observed in the animals operated upon by these two methods. The operation by suturing required usually more than an hour, and almost all of the animals showed more or less symptoms of shock after its completion, and not a few succumbed to its immediate effects: while the operation by approximation plates could always be finished within twenty minutes, consequently, the animals never suffered seriously from the immediate effects of the operation. The first experiments were made somewhat carelessly and with crude material, and yet it was observed that the healing process progressed more favorably and was accomplished in a shorter time than after suturing. The approximation discs brought into uninterrupted contact, large serious surfaces without impairing the vascular supply, at the same time they secured for the parts destined to become united an essential condition for rapid wound healing—rest—by serving the useful purpose of splints.

*Experiment 63.*—Dog, weight 15 pounds. Ileum was completely divided at its junction with the jejunum and both ends of the bowel closed by invagination, and three stitches of the continued suture. An incision was made on convex side of bowel about two inches from

<sup>1</sup>Read in the Surgical Section of the Ninth International Medical Congress, Washington, September 5, 1887.

the closed ends, and a heavy perforated lead plate to which six catgut sutures were fastened around the oval perforation was introduced into the lumen of the bowel of each closed end, all of the catgut sutures being brought out through the incision. The two wounds were brought opposite each other and the six sutures tied. The serous surfaces of the two intestines over a surface corresponding to the size of the lead discs were thus brought into accurate apposition. The sutures were cut short and the ends buried as deeply as possible. The condition of the animal remained excellent until the time of killing, 75 days after operation. Omentum adherent to wound; large intestines distended with normal faeces. Bowel above and below point of operation normal in size and structure. New opening between ileum and jejunum large enough to admit the little finger to second point. Bowels firmly united by a broad surface. Above the communicating opening a double flexion of the bowel was found which apparently had done no harm.

*Experiment 64.*—Dog, weight 18 pounds. Operation done in the same manner as in the last experiment, only that instead of lead the discs were made of sole leather, and the sutures used were linen in place of catgut. For a few days the temperature was higher than normal and appetite diminished. After fourth day the animal appeared to be in excellent condition and remained so for three weeks, when the appetite failed and occasional attacks of vomiting set in. These symptoms remained more or less prominent until the time of killing, 39 days after operation. Omentum adherent to abdominal wound; extensive intestinal adhesions at site of operation; union between intestines perfect. On incising the bowel it was found that the plates had sloughed through and had passed along the distal portion of the bowel, leaving an opening the size of the plates, the margins of which had almost completely cicatrized. The two leather plates still held together by the linen sutures were found three feet lower down in the ileum where they had become embedded in a mass of hair, straw and faecal matter, and quite firmly impacted, causing complete obstruction of the bowel. The intestine above the seat of obstruction was enormously dilated, while below the seat of impaction it was empty and contracted. Large intestines likewise empty and contracted. The cause of the illness was evidently due to intestinal obstruction produced by the impaction of the large enterolith in the centre of which the leather discs were found.

*Experiment 65.*—Dog, weight 10 pounds. In this instance the bowel was divided near the junction of the jejunum with the ileum,

both ends closed and its continuity established by incising the convex surface of both ends and approximating the wounds by two perforated bone plates tied together by silk ligatures. The animal died 14 days after operation. During the last few days symptoms of intestinal obstruction were present. Abdominal wound completely united. Numerous intestinal adhesions at site of operation. Bone plates still *in situ* and firmly fixed. On proximal side perforation of bone plates completely closed by hair and fragments of bone, giving rise to complete intestinal obstruction. The bowel above this point was greatly dilated, while on distal side it was empty and contracted. Adhesions between the two intestinal surfaces included by the bone plates firm. Intestinal obstruction by a mechanical arrest of portion of the intestinal contents above the proximal plate had caused death before a more efficient communication could be established by sloughing through of the bone plates.

*Experiment 66.*—Dog, weight 30 pounds. Ileo-ileostomy by dividing the ileum near its centre, closing both sides, and after incising both ends on convex surface, brought wounds in apposition by perforated plates of cross-grained walnut wood, which were tied together with silk sutures. The dog remained in perfect health and was killed 18 days after operation. External wound completely united. Plates had become detached, leaving a communicating opening 2 inches in length. Blind ends of bowel empty; no trace of plates could be found.

*Experiment 67.*—Dog, weight 24 pounds. Double ileo-ileostomy. Ileum divided transversely five inches above ileo-caecal region and both ends closed by invagination, and three stitches of the continued suture. Lower and upper end of bowel were again brought into communication by incision on convex side and lateral apposition of wounds by means of perforated approximation plates of decalcified bone, hardened in alcohol. The plates were fastened together by four silk sutures; all of the threads being brought out of the incision, tied and cut short. Above this point a loop of the ileum was made by bringing the convex surfaces into apposition after incision at two points, and introducing perforated gutta percha plates which were retained in place by four silk sutures. No fever or symptoms of obstruction followed the operation. Animal killed 13 days later. External wound firmly united. No evidences of peritonitis or intestinal obstruction. First operation left a communicating opening large enough to admit the little finger in one of its margins. The silk ligatures which had become detached from the plates had embedded themselves. The

decalcified bone plates had disappeared and no trace of them could be found in any portion of the intestinal canal lower down. The second operation was 30 inches higher up. Gutta percha plates remain *in situ*, although somewhat loosened by the gradual disappearance of the intervening tissues by pressure atrophy. Adhesions between the two surfaces of the bowel firm and extending a little beyond the line of approximation. The perforation in the proximal plate almost completely closed by an accumulation of hair. The entire ileum normal in size and appearance.

*Experiment 68.*—Dog, weight 54 pounds. Transverse section of ileum 30 inches above ileo-caecal region and closure of both ends in the usual manner. The two closed ends were overlapped 4 inches and brought into communication by two longitudinal openings which were approximated by being buttoned together with a shuttle-shaped button, nearly  $1\frac{1}{2}$  inches in length, the sides being lead plates and the shaft a rubber tube through which the anastomosis was established at once. As the margins of the intestinal wounds showed a tendency to evert, a fine catgut suture was inserted on each side embracing only the peritoneal coat. Only for two or three days after the operation did the dog not appear to be well. Killed 23 days after operation. Omentum adherent to abdominal wound which was firmly united. Omental adhesions to intestine at site of operation. Intestinal anastomosis 30 inches above the ileo-caecal valve. Proximal blind end of bowel five inches in length adherent to distal end, considerably dilated and contains fragments of bone and other crude substances. Approximation button *in situ* and quite firmly fixed. A fragment of bone partly fills the lumen of the rubber tube. Coaptated peritoneal surfaces firmly adherent. The obstruction of the communicating tube had given rise to dilatation of the bowel above the point to twice its natural size, while below the seat of partial obstruction the intestine appeared empty and contracted.

*Experiment 69.*—Small dog. In this experiment the ileo-ileotomy was made by lateral apposition by perforated approximation plates of partially decalcified bone tied together by four catgut sutures. The lateral sutures were passed through the margins of the wound near its border, a modification of the usual procedure, which not only fixed the plates firmly in their places, but also prevented ectropium of the mucous membrane, and ensured free patency of the new opening by retracting the margins of the wound, so that the longitudinal slit is at once transformed into an oval shape. The animal showed no unfavorable symptoms and was killed 29 days after operation. Dog well

nourished. External wound united. Omentum adherent to wound and intestines. The proximal blind end of bowel contained one of the bone plates which showed signs of softening and disintegration. The bone plate in the distal end had been passed with faeces previously. The new opening perfect and sufficiently large to equal in size the lumen of the bowel.

*Experiment 70.*—Dog, weight 12 pounds. Made ileo-ileostomy the same as in the last experiment, using decalcified, perforated bone plates, which were tied together with four catgut sutures, the lateral ones being passed through the margins of the wound. An omental flap was used to cover the sides of the bowel where approximation had been made. This flap was retained by two fine catgut sutures. No unfavorable symptoms. Animal killed 23 days after operation. Omentum adherent to distal blind end. Omental flap in position and firmly adherent. Site of operation 14 inches above ileo-caecal region. Both bone plates had disappeared and no trace of them could be found. Some hair had collected in the blind proximal end. New opening large enough to admit the index finger.

**REMARKS.**—Jejuno-ileostomy and ileo-ileostomy by internal apposition with decalcified perforated bone plates in cases of complete obstruction of the bowel artificially produced is an operation almost devoid of danger. Partially or completely decalcified bone plates hardened in alcohol remain firm for a sufficient length of time to answer the purpose of retentive measures until firm adhesions have formed between the serous surfaces held by them in approximation. Until it was ascertained by experiment that the plates would undergo softening and disintegration in the course of a few days, catgut sutures were used to hold them in place with the expectation that the plates would become detached and escape with the intestinal contents as soon as the sutures would give way. Experience, however, has shown that aseptic silk threads are preferable to catgut, as they can be tied with greater accuracy and the knots will never become loosened, while the approximation discs disappear completely by softening and disintegration in a few days. Approximation plates of inabsorbable material as lead, wood, leather, bone, and gutta percha, fastened together by silk or linen sutures remain *in situ* until the interposed tissues disappear by pressure atrophy, and the opening that results

corresponds in size to the dimensions of the plates. In the first experiments the plates were tied together by six sutures, but it was found that four sutures answered the same purpose. As a rule, the plates were about  $2\frac{1}{4}$  inches in length, and their width corresponded to one-third of the circumference of the bowel. The greatest advantage to be found in the method of restoring the continuity of the intestinal canal by lateral apposition by approximation discs consists in the fact that the point of contact is always made on the convex surface of the intestines, so that the means resorted to to secure coaptation do not interfere with the blood supply from the mesenteric vessels. As this method requires much less time than any form of circular enterorrhaphy, and has been followed almost without exception by recovery, it recommends itself strongly as a substitute for the latter procedure in many cases where loss of time constitutes an important factor in the issue of the case, or where from other causes circular suturing appears impossible or impracticable.

### 3. ILEO-COLOSTOMY.

As the ileo-cæcal region is frequently the seat of intestinal obstruction it becomes desirable to devise some definite plan of operative treatment in cases where the cause of obstruction is not amenable to removal with a view of establishing the continuity of the intestinal canal, thus avoiding the necessity of resorting to the formation of an artificial anus. To accomplish this object two distinct methods were followed : (1) Division of the ileum with closure of distal and implantation of proximal end into colon. (2) Division of ileum, closure of both ends and lateral apposition of proximal end with colon, and the formation of an intestinal anastomosis by suturing or approximation discs.

#### (a) ILEO-COLOSTOMY BY IMPLANTATION.

*Experiment 71.*—Dog, weight 38 pounds. Intestinal anastomosis by implantation of the ileum into colon. The ileum was divided transversely just above the ileo-cæcal region, and the distal end closed by invagination and 3 stitches of the continued suture, and dropped

back into the abdominal cavity. A longitudinal incision in size corresponding to the lumen of the ileum was made in the ascending colon at a point directly opposite the mesenteric attachment, and the proximal end of the ileum was then fixed in this opening by Czerny-Lembert sutures. Only slight febrile reaction followed the operation. The appetite remained good and the discharges from the bowels were normal. The animal was in excellent condition when killed, 33 days after operation. Few circumscribed omental adhesions to abdominal wound, which was completely closed. Peripheral portion of ileum presents a conical appearance, and was found adherent to, and of the same length as the appendix vermiciformis. Implantation had been done about the middle of the colon. Union at point of suturing perfect, apparently no interruption of continuity of peritoneal surface. The new opening into colon a little smaller than the lumen of the ileum. Around the margins of this opening, which somewhat resembles the ileo-caecal valve, six of the deep silk sutures remain attached. Above the new opening the colon and cæcum were found empty and somewhat atrophic. Lower portion of the ileum and colon below the new opening appear normal in size and structure.

In the remaining experiments the implantation was made by lining the proximal end of the ileum with a narrow flexible rubber ring, which was retained in place by a continued catgut suture, embracing the free margin of the bowel and the lower margin of the rubber ring. The implantation was made by two catgut sutures threaded each by two needles and passed at opposite points from within outwards through the upper margin of the ring and the entire thickness of the bowel, while the needles were only passed through the serous and muscular coat of the colon. After both sutures were in place gentle traction upon all of the ends brought the end of the ileum into the incision in the colon, and the walls of the colon were drawn over the end of the ileum to the points where the needles emerged from the ileum, making really a limited invagination. When in proper position, the serous surfaces of the colon and ileum over a surface corresponding to the width of the rubber ring were in accurate coaptation, after the two sutures were tied. Only in exceptional cases was it found necessary to apply one or two additional superficial coaptation sutures. As in circular enterorrhaphy, so in these cases, the elastic pressure on part of the rubber ring rendered material assistance in maintaining accurate coaptation, while at the same time it secured rest for the sutured parts, and kept the new opening freely patent for the escape of intestinal contents into the colon.

This operation did not require one fourth of the time consumed in making an implantation by Czerny-Lembert sutures.

*Experiment 72*.—Dog, weight 50 pounds. Division of ileum eight inches above ileo-caecal region, distal end closed by invagination, and three stitches of the continued suture. Proximal end lined with rubber ring and implanted into incision of ascending colon by two catgut invagination sutures. The dog did not appear to do well after the operation, and died on the 5th day. Abdominal wound not united. Partial separation of implanted bowel and diffuse septic peritonitis from perforation.

*Experiment 73*.—Dog, weight 35 pounds. Ileum divided 12 inches above ileo-caecal region, distal end closed and proximal end lined with flexible rubber ring and implanted into an incision in the transverse colon and retained by two invagination sutures of catgut. An omental flap an inch and a half in width was placed over the junction of the two intestines and fixed in its place by two catgut sutures. No unfavorable symptoms after operation. Animal when killed, 18 days later, in excellent condition. Omentum adherent to abdominal wound which was firmly united. Omental flap adherent all round. Colon above new opening ten inches in length, completely empty, contracted and atrophic. New opening oval in outline and as large as the lumen of the ileum.

*Experiment 74*.—Dog, weight 16 pounds. Division of ileum, closure of distal end and implantation of proximal into an incision of the colon by rubber ring and two invagination sutures of catgut. As the inverted portions of the colon showed a tendency to evert, two additional retaining sutures of fine catgut were used which secured perfect coaptation throughout. An omental flap was laid over the junction of the intestines and fixed in its place by one catgut suture. The dog remained in good condition, appetite unimpaired, and discharges from bowels normal. Killed 13 days after operation. Abdominal wound firmly united. Omentum adherent to wound. A number of adhesions between coils of intestine. Ileum somewhat dilated above the new opening. Omental flap in place and adherent. Union between ileum and colon perfect. A long, sharp fragment of bone was found lodged just above the new opening, its lower end partially occluding its lumen. The dilatation of the lower portion of the ileum was evidently due to partial obstruction from the presence of the foreign body in the new opening.

*Experiment 75*.—Dog, medium size. Section of ileum two feet above the ileo-caecal region, closure of distal end in the usual manner

implantation of proximal end into colon by rubber ring and two invagination sutures of catgut. No omental flap. Animal remained well and was killed 43 days after operation. Omentum adherent to abdominal wound. Distal end of ileum conical in shape, the extremity presenting a cup-shaped depression, which was filled with cicatricial material. Omentum adherent at ileo-cæcal region and at site of operation. Union between the bowels perfect and their serous surfaces appear to be continuous over the line of junction. The new opening from the colon admits the little finger, and is surrounded by a prominent ridge of mucous membranes, which resembled the ileo-cæcal valve.

*Experiment 76.*—Dog, weight 14 pounds. Division of ileum a few inches above ileo-cæcal valve, distal end closed by invagination, and 3 stitches of continued suture. Implantation of proximal end into colon by rubber ring and two catgut invagination sutures. Over the junction of the two intestines an omental flap was placed which was retained by a catgut suture. The animal showed no unfavorable symptoms and was killed 23 days after operation. Omental flap retained and firmly adherent throughout. Point of implantation three inches above cæcum; union between the two intestines firm throughout. New opening corresponds in size to the lumen of the ileum, and is surrounded by a prominent ridge of mucous membrane which appears to be derived from the invaginated portion of the ileum.

*Experiment 77.*—Ileum divided a few inches above ileo-cæcal region, and after closure of distal, the proximal end was implanted into the colon in the usual manner by means of rubber ring and two invagination sutures of catgut. Animal died on the third day after operation. Wound partially united; a considerable quantity of sero-sanguinolent fluid in the abdominal cavity. Ileum almost completely separated from colon, and the portion which had been invaginated showed signs of gangrene. Rubber ring had disappeared; death from perforative peritonitis. In this case we have reason to believe that the rubber ring which was used was too large and that the gangrene and separation was due to injurious pressure.

#### (b) ILEO-COLOSTOMY BY LATERAL APPPOSITION.

Anastomosis by this method was made after producing an intestinal obstruction of some kind at or near the ileo-cæcal region, and then by bringing the ileum above the seat of obstruction in communication with the colon below the point of

obstruction by making an incision an inch and a half to two inches in length in both intestines at a point opposite the mesenteric attachments, and uniting the wounds either by a double row of sutures or perforated decalcified bone discs. The first experiments were all made by suturing, but as in a circular enterorraphy it was found by experience that perforation not infrequently occurred along the track of one of the sutures, in some instances several days after the operation, at a time when union had taken place by firm adhesions. These unfavorable results led to the use of the approximation discs.

*Experiment 78.*—Dog, weight 25 pounds. The ileum was withdrawn from the abdomen through an incision in the linea alba and having emptied a loop of its contents acute flexion was made just above the ileo-cæcal region by approximating the serous surfaces of the convex side for an inch and a half by five catgut sutures. Two longitudinal incisions of equal size were made, one in the ileum six inches above the flexion, and the other in the ascending colon three inches above the cæcum. The visceral wounds were carefully united by Czerny-Lembert sutures, using silk for the deep interrupted sutures, and fine catgut for the superficial continued sutures. No untoward symptoms were observed after the operation; appetite remained unimpaired, and faecal discharges were normal. The dog was killed 37 days after operation. Animal well nourished. No evidences of peritonitis. Bowel above point of obstruction nearly empty, and somewhat contracted as far as the new opening. Flexion permeable to a stream of water. Slight omental adhesions to bowel at site of operation; union firm throughout. Lumina of non-excluded portion of bowel normal in size above and below the flexion. Serous surfaces at point of junction appear perfect and continuous. On slitting open the colon opposite the new opening its outlines were seen to be marked by a prominent ridge of mucous membrane to which a number of the deep sutures remained attached. The opening was large enough to admit the tip of the middle finger. The excluded portion of the colon and the cæcum were somewhat contracted and atrophic and contained only a very small quantity of faecal matter.

*Experiment 79.*—Medium-sized cat. About two inches of the ileum were invaginated into the colon through the ileo-cæcal valve, and the intussusceptum stitched to the neck of the intussuscipiens by two fine catgut sutures. Continuity of the intestinal canal restored

by incising the ileum above the obstruction and the ascending colon below the free extremity of the intussusceptum and uniting the wounds by a double row of sutures. The invagination caused no serious disturbance, and the animal remained in good health and was in excellent condition at the time of killing, 162 days after operation. A number of adhesions between the folds of the intestines near the site of operation. At point of junction of the two intestines the peritoneal surface presented a glistening and continuous surface. New opening an inch and a half in length, oval in outline and located five inches above the ileo-cæcal region. Two inches below the opening the invagination remains in the shape of a circular thickening of the bowel with a narrowing of its lumen to more than one-half of its normal size. A close inspection of the specimen shows that no gangrene has occurred, but that the intussusceptum has undergone atrophy. A stream of water passing along the ileum in a downward direction escapes through the invaginated portion and through the new opening, the stream from the latter being at least three times larger than the one through the intussusceptum. Excluded portion of ileum and colon empty and very much atrophied and contracted. Below the new opening the colon and rectum contain normal faeces in considerable quantity.

*Experiment 80.*—Young cat. Ileo-cæcal invagination; length of intussusceptum four inches, and in order to prevent spontaneous invagination the bowel was fixed in its position by two fine catgut sutures. Ileo-colostomy below the lower end of the intussusceptum by lateral apposition and suturing. Animal died on the fourth day after operation. Abdominal wound united. Diffuse peritonitis from perforation at site of suturing. Length of intussusceptum reduced from four inches to two inches and a half. It was found impossible to effect reduction by traction on account of firm adhesions at neck of intussusciens. No gangrene.

*Experiment 81.*—Adult, large dog. Intestinal obstruction was produced by making two sharp flexions near the ileo-cæcal region by folding the bowel on its side and fixing it in this position by fine catgut sutures; the apices of the flexions were sutured together so as to render the obstruction more complete. Intestinal anastomosis was established by lateral apposition and suturing. Physical condition of dog remained good throughout; appetite and evacuations normal. Killed 31 days after operation. No peritonitis; a number of omental adhesions at point of operation. Flexions quite sharp, rendering the bowel nearly, if not completely, impermeable at this point. Perfect

union between bowels, with some thickening of their walls by inflammatory exudation. New opening oval in shape, an inch and a half in length, a few of the deep sutures still remaining attached to its margins. Excluded portion of bowel empty and somewhat atrophic.

*Experiment 82.*—Dog, weight 13 pounds. Obstruction of the bowels made by an acute flexion four inches above the ileo-caecal region, retained by four catgut sutures. Intestinal anastomosis by an opening an inch and a half in length which brings into communication the ileum above the obstruction and the descending colon. The animal showed no untoward symptoms, and was killed 41 days after operation. A number of intestinal folds agglutinated by adhesions; no evidences of diffuse peritonitis. Where the flexion had been made the loop of intestine is connected by a broad band of adhesion which gives to the bowel a horse-shoe shaped appearance. Intestine below the seat of flexion contains a small amount of hardened faeces. Colon and caecum above the new opening nearly empty and greatly contracted. Line of suturing somewhat thickened. New opening oval in outline and about an inch in length, surrounded by a corrugated elevation of mucous membrane. A stream of water passed through the bowel from above downward readily escapes through the new opening, while only a small stream can be forced through the flexion.

*Experiment 83.*—Dog, weight 27 pounds. A volvulus was made six inches above the ileo-caecal region by rotating an empty loop of the intestine once around its axis and fixing it in this position by three catgut sutures. Intestinal anastomosis between the ileum above the volvulus and the descending colon by lateral apposition and suturing. For four days after the operation the evacuations from the bowels contained blood; after this time the stools were normal. Dog in excellent condition when killed, 31 days after operation. No signs of diffuse peritonitis. The portion of bowel which constitutes the volvulus adherent, contracted and empty. Water can be readily forced through this part of the bowel. Caecum and colon above new opening empty and contracted. Size of new opening larger than the lumen of the ileum, its margins surrounded by a prominent ridge of mucous membrane to which a few of the deep sutures still remain attached. In this experiment nearly the entire colon was excluded, consequently the faecal discharges were quite frequent and fluid or semi-fluid in consistence.

*Experiment 84.*—Dog, weight 17 pounds. Two inches of the ileum were invaginated into the caecum. Ileo-colostomy by uniting the ileum with the transverse colon by suturing. The animal appeared quite ill after the operation and died on the fifth day after having manifested

well marked symptoms of perforative peritonitis. Abdominal wound not united. Only partial union between the intestines at point of junction. Diffuse septic peritonitis from perforation.

REMARKS.—In at least two experiments which are not here reported the animals died a few hours after operation of shock. In a number of other experiments the operation was followed by more or less shock, but the animals, without receiving any special treatment, rallied after 6 to 12 hours. The symptoms referable to the immediate effects of the operation were due to the length of time required in applying a double row of sutures in uniting the visceral wounds, a step in the operation which always required from 30 minutes to an hour. These experiments only corroborate the statement previously made that the excluded portion of the intestinal canal, including the obstruction, does not become the seat of faecal accumulation, but undergoes atrophy after free intestinal anastomosis has been established between the intestine above and below the seat of obstruction. Experiments Nos. 68 and 69 furnish most striking proof that the danger of gangrene in cases of invagination is greatly diminished by establishing an early intestinal anastomosis, as when this is done the violent peristalsis is promptly arrested by furnishing a new outlet to the intestinal contents; at the same time the serious consequences resulting from pressure and distention above the obstruction are likewise promptly averted. In cases of intestinal anastomosis where nearly the entire colon has been excluded, the fluid contents of the small intestines reach the rectum at once, and cause frequent fluid faecal discharges, an occurrence which does not appear to impair the general health of the animal. The new opening should be made of adequate size so that its lumen will at least correspond to the lumen of the bowel above the obstruction.

(c) ILEO-COLOSTOMY BY PERFORATED APPROXIMATION DISCS.

*Experiment 85.*—Dog, weight 20 pounds. The ileum was completely divided three inches above the ileo cæcal region, both ends closed by invagination and three stitches of the continued suture.

A communication was established between the proximal extremity and the colon, by making an incision into the ileum on convex side near the close end and introducing through this opening a perforated decalcified bone plate. A similar opening was made into the ascending colon opposite its mesenteric attachment through which a perforated plate of wood was introduced. To each plate were tied four catgut sutures. The lateral sutures were passed through the margins of the wound. After the plates and sutures were in place the wounds were brought in contact and the four sutures tied, which coaptated the serous surfaces of both bowels over an area corresponding to the size of the plates. The animal remained apparently well for two days, when symptoms of peritonitis set in and death occurred five days after operation. Diffuse peritonitis. Union at point of operation incomplete which resulted in a perforation. Discs had disappeared. As the catgut sutures were quite fine it is more than probable that partial separation of the plates occurred before adhesions had taken place between the serous surfaces of the coaptated bowels, which resulted in perforation and death from diffuse septic peritonitis.

*Experiment 86.*—Dog, weight 15 pounds. Invagination of colon into colon to the extent of two inches. Intestinal anastomosis by making an ileo-colostomy by lateral apposition of the ileum to colon below invagination, using perforated hard rubber plates which were tied together by four catgut sutures, the lateral sutures being passed through the margins of the wound. After tying the sutures it was found that at one point the margins of the wound showed a tendency to evert, consequently a fine catgut suture was passed through the peritoneum only and tied. The animal did not appear bright the day after the operation, but subsequently showed no signs of suffering; killed 24 days after operation. Abdominal wound firmly united. Omentum adherent to wound and at point of operation. The invagination was partially reduced. The bowel at this point was curved in the shape of a horse-shoe, but permeable to a stream of water. Excluded portion of colon tortuous and atrophic. Cæcum contained a small quantity of fluid faeces. Plates could not be found. New opening sufficiently large for free passage of intestinal contents.

*Experiment 87.*—Dog, weight 15 pounds. Ileum divided transversely 15 inches above the ileo-cæcal region; both ends closed in the usual manner. Ileum and colon approximated by decalcified perforated bone plates which were tied together by four catgut sutures, the lateral ones transfixing the margins of the wound. On the second day the evacuation from the bowels contained traces of blood. Animal killed

18 days after operation. Abdominal wound completely healed. Omentum adherent to wound. Numerous adhesions between the intestinal folds. Proximal blind end of ileum had been changed into a pouch-like form and contained a mass of hair and fragments of bone. One very sharp spiculum of bone had nearly perforated the intestine. New opening corresponds in size to the lumen of the ileum.

**REMARKS.**—The operations of lateral apposition of ileum to colon by perforated approximation discs, have shown that it is unsafe to rely upon catgut as a suturing material, as when fine catgut is used coaptation is not maintained for a sufficient length of time for adhesions to take place, and coarse catgut when tied interferes with accurate approximation, as the knots after tying mechanically separate the serous surfaces. It is advisable to use removable plates and to tie with silk. The results of ileo-colostomy made by approximation discs have not been as favorable as after jejunoo-ileostomy or ileo-ileostomy, and in repeating the operation on man it would be indicated after bringing the intestines in apposition by tying the four sutures to apply a number of superficial sutures for the purpose of still further guarding against the escape of gas or fluid contents into the peritoneal cavity. The plates when properly fixed in their places and tied together with sufficient firmness not only coaptate an extensive area of serous surfaces, but they at the same time secure perfect rest for the parts which it is intended to unite, until firm adhesions have formed.

#### ILEO-RECTOSTOMY.

In cases of intestinal obstruction due to inoperable conditions low down in the colon it becomes necessary to establish an intestinal anastomosis between the ileum and the rectum, in order to avert the necessity of making an artificial anus, in other words, to make an ileo-rectostomy. The operation can be made in the same way as establishing a communication between the ileum and the colon by lateral implantation, by lateral apposition and double suturing or by lateral apposition by perforated decalcified bone plates. The operation is however more difficult because the rectum is not as accessible as the colon, and from the greater vascularity of the gut the in-

cision is more liable to give rise to troublesome haemorrhage. While the slight haemorrhage from an incision into the small intestines and the colon is usually promptly arrested by suturing or compression by the approximation discs, the bleeding from a wound of the upper portion of the rectum not infrequently requires the application of one or more catgut ligatures before it is safe to unite the wounds. During the operation traction must be made upon the rectum in an upward direction so as to lift the upper portion of the bowel out of the pelvis. In both of the experiments described below, the wounds were united by Czerny-Lembert sutures.

*Experiment 88.*—Dog, weight 90 pounds. Invagination of colon into colon for two inches and suturing of intussusceptum to neck of intussuscipiens by four fine silk sutures to prevent spontaneous disinvagination. Ileum incised in a parallel direction for an inch and a half on convex side and this wound united with a similar incision in the rectum on its anterior surface by a double row of sutures. For the purpose of immobilizing the sutured intestines an additional fine catgut suture was applied above and below the place of suturing, embracing only the peritoneal and muscular coats of the intestines. On the third, fourth, and fifth days the faecal discharges contained blood and mucus. On the sixth day the abdominal wound partially opened, and a considerable quantity of sero purulent fluid escaped. Death seven days after operation. Abdominal wound not united. Diffuse purulent peritonitis. Numerous intestinal adhesions. Invagination retained; adhesions between the intussusceptum and intussuscipiens; no gangrene; perforation at point of operation.

*Experiment 89.*—Cat, weight 7 pounds. Ileo-rectostomy by lateral implantation. The ileum was cut across transversely an inch above the ileo-caecal valve, and the distal end closed by invagination, and three stitches of the continued suture. The proximal end was transplanted into a longitudinal incision on the anterior surface of the upper portion of the rectum by Czerny-Lembert suture. With the exception of an occasional slight rise in temperature no serious disturbances were observed during the progress of the case. The evacuation of the small intestines directly into the rectum appeared to increase the peristaltic action of the rectum as the faecal discharges were fluid and frequent. Animal killed 20 days after operation. Abdominal wound completely united. No peritonitis. A few folds of the small intestines and the omentum adherent to the wound. Insertion of

ileum into rectum in an oblique direction ; union at point of junction complete throughout ; intestinal coats at this point somewhat thickened. Peritoneal surface smooth and continuous from one bowel to the other. New ileo-rectal opening corresponds in size to the lumen of the ileum ; margins of this opening consist of a ridge of mucous membrane to which a row of the deep sutures remain attached. Excluded portion of large intestine empty and contracted. Rectum contained a small quantity of fluid faeces.

[TO BE CONCLUDED.]